Towards Mobile Sensing of Attention and Distraction

Marco Gruteser
WINLAB, Electrical and Computer Engineering Department
The Distracted Driving Challenge
Connected Vehicles and Mobile Devices

- **Automotive safety**
  - Obstacle/slow-traffic-ahead warning
  - Red-light warning
  - Active Collision Avoidance

- **Efficient Pricing and Payment**
  - “Pay-as-you-drive” insurance
  - Highway tolls
  - Gas station payments

- **Entertainment**
  - Video, Web, Gaming

- **Congestion Management**
  - Real-time traffic information
  - Navigation traffic-aware travel time optimization
  - Improved information for traffic engineering

- **Point-of-Interest Queries**
  - Finding nearby hotels, gas stations; travel guides, local entertainment

- **Fleet management**
  - Tracking fleet of company vehicles
Hand-Held Cell Phone Bans

United States Cell Phone Laws
- Yellow: Hand-Held Cell Phone Ban – All Drivers
- Orange: Texting While Driving Ban – All Drivers
- Blue: Hand-Held Cell Phone Ban for Young and/or Novice Drivers Only
- Gray: No Ban
Existing Apps: Cell Phone Blocking

In-Vehicle Detection Methods

GPS

Handover

Signal Strength

Car’s speedometer (via OBD2)
The Driver-Passenger Challenge

I want to make a phone call.

38% of automobile trips include passengers!

Source: National highway traffic safety administration: Fatality analysis reporting system
An Acoustic Ranging Approach

- No need for dedicated infrastructure
  - Car speakers
  - Bluetooth
- Classifying on which car seat a phone is being used
  - No need for localization or fingerprinting
    - Exploiting symmetric positioning of speakers
Low-infrastructure Inertial Approach

Tangential speed:
\[ v_{LD} < v_{LM} < v_{LP} \]

Centripetal acceleration:
\[ a_{LD} < a_{LM} < a_{LP} \]
Accumulating Turns Improve Results

Detection Rate vs. False positive rate

- Blue line: 1 set of mixed turns
- Green line: 2 sets of mixed turns
- Red line: 3 sets of mixed turns
Front vs. Rear
Front vs Rear

(a) Driver’s seat
Quo Vadis?
CAMP VSC3 - Communications Scalability for V2V Safety
Impact of Sensors and Automated Driving?

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Managing Driver Attention

Source: Continental Press Release, 2013
Wireless camera communications?
Visual MIMO

Fundamental Differences to RF MIMO:
• Channel dominated by perspective distortion
• Larger array size vs low sampling rate
Optical Wireless Opportunities

- Optical can complement RF to improve reliability, particularly in RF interference-limited scenarios
- Precise angle-of-arrival detection (and localization)
- Could reuse existing head- and tail-light LED arrays as transmitters
Two hours prior to each performance of West Side Story at the Palace Theatre, patrons will be invited to enter a lottery drawing for a limited number of $26.50 tickets to that day's performance.
Towards the Augmented Driver
Thank you

Collaborators:
Ashwin Ashok, Wenjia Yuan, Jie Yang, Yan Wang,
Simon Sidhom, Tam Vu, Janne Lindqvist,
Yingying Chen, Rich Martin, Kristin Dana,
Narayan Mandayam

WINLAB, Rutgers University/ Stevens Institute of Technology